AN **1997:264572** HCAPLUS
DN 126:241373
TI Copper alloys for motor commutator materials
IN Mae, Yoshiharu; Yajima, Kenji; Ishida, Tokukazu
PA Mitsubishi Materials Corp, Japan
SO Jpn. Kokai Tokkyo Koho, 5 pp.
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AB Title Cu alloys contg. 7.5-15% Ag, 1-50 ppm O2, and 0.05-1.2% Cr and/or 0.01-0.25% Zr have dispersed structure of 100-10,000/mm2 pptd. compds. with 0.2-5 .mu.m. The materials have good wearing resistance.

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(54)【発明の名称】　モーター整流子材

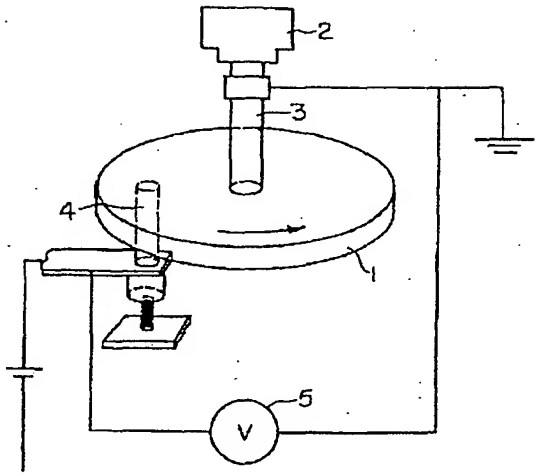
(57)【要約】
【課題】　耐摩耗性およびアーク発生の少ないモーター整流子材を提供する。
【解決手段】重量％で、Ａｇ：７．５～１５％、酸素：１～５０ｐｐｍを含有し、さらに、Ｃｒ：０．０５～１．２％、Ｚｒ：０．０１～０．２５％の内の１種または２種を含有し、残りがＣｕおよび不可避不純物からなる組成、並びに素地中に０．２～５μｍの析出物が１００～１００００個／ｍｍ^2 分散した組織を有するＣｕ合金からなるモーター整流子材。

【図1】整流子材およびCu含浸カーボンブラシの摩耗量並びにアーク発生率を測定する方法を示す説明図である。

【符号の説明】

1　整流子材
2　電動モーター
3　軸
4　Cu含浸カーボンブラシ
5　電圧計

【図1】



PATENT ABSTRACTS OF JAPAN

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(71)Applicant : MITSUBISHI MATERIALS CORP

(72)Inventor : MAE YOSHIHARU
YAJIMA KENJI
ISHIDA TOKUKAZU

4) MOTOR COMMUTATOR MATERIAL

7)Abstract:

ROBLEM TO BE SOLVED: To produce a motor commutator material having wear resistance and small in
e generation of arcs.

)LUTION: This motor commutator material consisting of a Cu alloy has a compsn. contg., by weight, 7.5
15% Ag and 1 to 50ppm oxygen, furthermore contg. one or two kinds of 0.05 to 1.2% Cr and 0.01 to
!5% Zr, and the balance Cu with inevitable impurities and has a structure in which precipitates of 0.2 to 5
ı are dispersed in the matrix by 100 to 10000 pieces/mm2. The material is small in mating attackability.

GAL STATUS

ıte of request for examination]	30.09.1999
ıte of sending the examiner's decision of rejection]	
ıd of final disposal of application other than the ıminer's decision of rejection or application ıverted registration]	abandonment
te of final disposal for application]	24.10.2001
tent number]	
te of registration]	
mber of appeal against examiner's decision of ction]	
te of requesting appeal against examiner's ision of rejection]	
:e of extinction of right]	

NOTICES *

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*** shows the word which can not be translated.
n the drawings, any words are not translated.

.AIMS

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laim]
aim 1] A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which oxygen:1-50ppm are
ıtained Ag:7.5-15% and Cr:0.05-1.2%, and the remainder becomes from Cu and an unescapable impurity by weight
and a base. Motor commutator material characterized by consisting of a Cu alloy which has the decentralized
;anization.
aim 2] Motor commutator material characterized by consisting of a Cu alloy which has the composition which
'gen:1-50ppm are contained Ag:7.5-15% and Zr:0.01-0.25%, and the remainder becomes from Cu and an
scapable impurity by weight %, and the organization which 100-10000 0.2-5-micrometer sludges /distributed two
es mm in the base.
aim 3] A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which oxygen:1-50ppm are
tained Ag:7.5-15%, Cr:0.05-1.2%, and Zr:0.01-0.25%, and the remainder becomes from Cu and an unescapable
urity by weight %, and a base. Motor commutator material characterized by consisting of a Cu alloy which has the
entralized organization.

ınslation done.]

TAILED DESCRIPTION

etailed description]
01]
ıe technical field to which invention belongs] This invention relates to the motor commutator material with few rates ırcing with little [and] abrasion resistance and the partner aggression.
02]
ior art] Although it is known conventionally that Cu alloy with which % contains Ag:(which shows weight % eafter)10% by weight % as for motor commutator material, and the remainder consists of Cu and an unescapable ɔurity will be used Recent years, Zr, Ag, Cr, Fe, Si, aluminum, B, calcium, Co, In, 0.05 - 7% is contained for one : in Mg, Mn, nickel, P, Pb, Sb, Sn, Te, Ti, and Zn, or two sorts or more in the sum. The composition which the ıainder becomes from Cu and an unescapable impurity, And the motor commutator material which was excellent in one layer abrasion resistance which has the precipitation organization which the precipitation grain not more than icle-diameter:1000 A distributed by grain-spacing:10-100 A in the base is proposed (refer to publication-number 37 [three to] official report). These motors commutator material is included in the motor, where Cu impregnation ɔon brush is contacted.
03]
ject of the Invention] As for various motors, it is asked for enhancement with the much more performance in recent s. for the reason While the rotational frequency of the commutator of a motor is raised, the forcing pressure of the ımutator of a motor and Cu impregnation carbon brush is enlarged so that the contact resistance of the commutator motor and Cu impregnation carbon brush may become small. the forcing pressure of the commutator of the ventional motor, and Cu impregnation carbon brush -- 0.2-0.5kgf/cm2 it was -- a thing -- present -- 0.7kgf/cm2 It eases to the above and the service condition of the motor commutator material of a motor is still severer. as tioned above, it is now although it is asked for the material of the motor commutator which wear of Cu regnation carbon brush also increases and can bear such a severe condition while the rate of arcing will increase if otational frequency of a commutator is raised, and wear of the commutator [itself] of a motor will increase, if the ing pressure of the commutator of a motor and Cu impregnation carbon brush is increased further -- it does not t
04]
means for solving a technical problem] Then, the result which inquired that this invention persons should get the anding motor commutator material which can bear a severe condition rather than the former from such a point, The motor commutator material which consists of a Cu alloy which many Ag is contained rather than the ementioned conventional motor commutator material, and Cr and Zr were added [alloy] fewer and made 1-50 of oxygen contain further Abrasion resistance improved much more rather than the aforementioned conventional ɔr commutator material, there were few rates of arcing and the knowledge of having the outstanding property was ired.
5] This invention is made based on such knowledge (1). It is weight %. Oxygen:1-50ppm are contained Ag:7.5- and Cr:0.05-1.2%. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder mes from Cu and an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy h has the decentralized organization (2), By weight % Oxygen:1-50ppm are contained Ag:7.5-15% and Zr:0.01- %. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder becomes from nd an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy which has the ıtralized organization. (3) A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which en:1-50ppm are contained Ag:7.5-15%, Cr:0.05-1.2%, and Zr:0.01-0.25%, and the remainder becomes from Cu

d an unescapable impurity by weight%, and a base. It has the characteristic feature in the motor commutator material
ıich consists of a Cu alloy which has the decentralized organization.
)06] In the motor commutator material of this invention, since Cu impregnation carbon brush which is partner
ıterial is worn while a degree of hardness will be too high and workability will fall as motor commutator material if
ş is preferably contained on the other hand exceeding 15% since having carried out Ag content to 7.5 - 15% runs
ɔrt of the intensity and hardness of motor commutator material if Ag becomes less than 7.5%, it is based on it not
ing desirable. The much more desirable composition domain of Ag content of the motor commutator material of this
/ention is 9.0 - 11.0%.
)07] Moreover, since Cr content was carried out to 0.05 - 1.2% because abrasion resistance and thermal resistance
)uld not be improved, if Cr becomes less than 0.05%, its arcing will increase on the other hand if Cr is contained
ceeding 1.2%, and workability also becomes bad, it is based on it not being desirable. The much more desirable
mposition domain of Cr content of the motor commutator material of this invention is 0.2 - 0.6%.
)08] Furthermore, since workability also becomes bad while arcing will increase if it contains on the other hand
:ferably exceeding 0.25% since thermal resistance runs short of this component at less than 0.01%, the ground which
ıited Zr contained in the motor commutator material of this invention to 0.01 - 0.25% is based on it not being
ɜirable. The much more desirable composition domain of Zr contained in the motor commutator material of this
'ention is 0.05 - 0.15%.
)09] Furthermore, since workability also becomes bad while arcing will increase if oxygen contains on the other
ıd preferably exceeding 50 ppm since the ground which limited the oxygen contained in the motor commutator
terial of this invention to 1-50 ppm requires a cost for setting oxygen to less than 1 ppm too much, it is based on it
: being desirable. The much more desirable composition domain of the oxygen contained in the motor commutator
terial of this invention is 1-15 ppm.
)10]
ɜstalt of implementation of invention] While Cu alloy was melted by the usual RF smelter and deoxidation
ɔcessing which stands was performed, the ingot which has the dimension (diameter:175mm and length:400mm)
ich has the component composition shown in Table 1 and 2 was produced by adjusting the amount of Ag, Cr, and Zr
ich are added in the molten metal which carried out the seal with solid-state carbon. After carrying out a cold-
wing manipulation after 720 degrees C and the hold during 60 minutes homogenize the obtained ingot until
ruded between heat and it carried out so that it might become a dimension (diameter:50mm and length:7600mm),
l it subsequently carried out water cooling with the cooling rate of 50 degrees C/second or more and it was further
to diameter:45mm, for 450 degrees C and 60 minutes, the hold carried out the aging treatment, the cold-drawing
nipulation was carried out further, and the diameter:40mm round bar made from Cu alloy was produced
11] The round bar made from these Cus alloy was cut to thickness:8mm, and the motor commutator material
nventionally henceforth commutator material) 1-4 was produced the disk-like this invention motor commutator
terial (henceforth this invention commutator material) 1-11, the comparison motor commutator material (henceforth
ıparison commutator material) 1-4, and conventionally. The cut surface of the obtained motor commutator material
ş ground, it observed with the metaloscope, the number of the 0.2-5-micrometer sludges currently distributed in the
-surface base of motor commutator material was measured, and the result was shown in Table 1 and 2. Cu
ɔregnation carbon brush which has the dimension (diameter:5mm and length:10mm) which made porous material
ɔon impregnate Cu furthermore was prepared.
12] The these disks-like commutator material 1 is attached in the shaft 3 of an electrical motor 2 as shown in
wing 1 . Cu impregnation carbon brush 4 is pushed against a 15mm place from the center of the disk-like
ımutator material 1, rotating the disk-like commutator material 1. making the graph which applied the constant
:age of 10V between the disk-like commutator material 1 and Cu impregnation carbon brush 4, measured the
:age which appears in a voltmeter 5, took the voltage along the axis of ordinate and took the resistance welding time
ıg the quadrature axis draw The abrasion test was performed on condition that the following, the abrasion loss and
rate of arcing of commutator material and Cu impregnation carbon brush were measured, and the result was shown
'able 1 and 2. In addition, since the voltage became less than [9V] when the arc occurred, the rate of the resistance
ding time from which the voltage to all the resistance welding times became less than [9V] was made into the rate
rcing.
13] Abrasion test condition **** current:15A (76.43A/cm2), **** voltage:10V, forcing pressure:250gf
.7kgf/cm2), turnover-time:24 hour, and rotational frequency:10000rpm.
14]
ɔle 1]

種別		成分組成（重量%、但しO_2（ppm）					析出物の個数（個/mm²）	整流子の摩耗量（mg）	Cu含浸カーボンブラシの摩耗量（mg）	アーク発生率（%）
		Ag	Cr	Zr	O_2（ppm）	Cu				
本発明整流子材	1	9.5	0.12	—	5	残	7500	430	9	10.2
	2	8.5	0.85	—	5	残	9200	550	8	14.3
	3	8.1	—	0.08	4	残	1500	520	7	8.4
	4	12.3	—	0.21	3	残	3200	400	12	9.3
	5	7.6	0.30	0.07	6	残	5300	410	10	12.3
	6	7.8	0.85	0.08	10	残	8500	580	11	13.2
	7	10.3	0.33	0.23	8	残	6200	470	11	12.5
	8	10.3	0.98	0.06	16	残	9400	620	12	14.0
	9	14.3	0.10	0.10	23	残	7900	440	10	11.4
	10	14.2	0.77	0.08	31	残	8800	570	11	10.7
	11	9.8	0.07	0.03	50	残	9500	640	13	17.2

)15]
able 2]

種別		成分組成（重量%、但しO_2（ppm）					析出物の個数（個/mm²）	整流子の摩耗量（mg）	Cu含浸カーボンブラシの摩耗量（mg）	アーク発生率（%）
		Ag	Cr	Zr	O_2（ppm）	Cu				
	1	5.4*	0.27	0.12	120*	残	22100	980	43	33.4
	2	17*	0.08	0.09	65*	残	12500	1050	47	39.6
	3	8.4	1.5*	0.12	18	残	25300	1140	38	28.8
	4	10.2	0.45	0.4*	6	残	15600	920	48	29.3
	1	11.3	—	—	—	残	—	925	8	9.4
	2	4.0	—	—	—	残	—	850	11	10.2
	3	0.03	0.02	0.03	—	残	5300	1020	13	12.3
	4	2.1	—	—	—	残	—	980	14	11.8

（*印は、この発明の条件から外れた値を示す）

.6]
ect of the invention] From the result shown in Table 1 and 2, this invention commutator material 1-11 Ag, Cr from ch it separated from the motor commutator material 1-4 and this invention conventionally, Compared with the parison motor commutator material 1-4 containing Zr and oxygen, there is little abrasion loss of the commutator erial [itself]. moreover, the rate of arcing is markedly alike, becomes large, and it turns out that the comparison

motor commutator material which there are few amounts which wear the carbon brush which is partner material, and ill has too many one sort or two sorts, and oxygen contents of Cr and the Zr is not desirable As mentioned above, the otor commutator material of this invention can raise the luminous efficacy of a motor, and the effect excellent in evelopment of electric industry is brought.

Translation done.]

ECHNICAL FIELD

The technical field to which invention belongs] This invention relates to the motor commutator material with few rates of arcing with little [and] abrasion resistance and the partner aggression.

Translation done.]

JOR ART

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ior art] Although it is known conventionally that Cu alloy with which % contains Ag:(which shows weight % reafter)10% by weight % as for motor commutator material, and the remainder consists of Cu and an unescapable purity will be used Recent years, Zr, Ag, Cr, Fe, Si, aluminum, B, calcium, Co, In, 0.05 - 7% is contained for one t in Mg, Mn, nickel, P, Pb, Sb, Sn, Te, Ti, and Zn, or two sorts or more in the sum. The composition which the nainder becomes from Cu and an unescapable impurity, And the motor commutator material which was excellent in one layer abrasion resistance which has the precipitation organization which the precipitation grain not more than ticle-diameter:1000 A distributed by grain-spacing:10-100 A in the base is proposed (refer to publication-number 437 [three to] official report). These motors commutator material is included in the motor, where Cu impregnation bon brush is contacted.

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anslation done.]

EFFECT OF THE INVENTION

Effect of the invention] From the result shown in Table 1 and 2, this invention commutator material 1-11 Ag, Cr from which it separated from the motor commutator material 1-4 and this invention conventionally, Compared with the comparison motor commutator material 1-4 containing Zr and oxygen, there is little abrasion loss of the commutator material [itself], moreover, the rate of arcing is markedly alike, becomes large, and it turns out that the comparison motor commutator material which there are few amounts which wear the carbon brush which is partner material, and 1 has too many one sort or two sorts, and oxygen contents of Cr and the Zr is not desirable As mentioned above, the motor commutator material of this invention can raise the luminous efficacy of a motor, and the effect excellent in development of electric industry is brought.

Translation done.]

CHNICAL PROBLEM

bject of the Invention] As for various motors, it is asked for enhancement with the much more performance in recent urs. for the reason While the rotational frequency of the commutator of a motor is raised, the forcing pressure of the nmutator of a motor and Cu impregnation carbon brush is enlarged so that the contact resistance of the commutator a motor and Cu impregnation carbon brush may become small. the forcing pressure of the commutator of the ıventional motor, and Cu impregnation carbon brush -- 0.2-0.5kgf/cm2 it was -- a thing -- present -- 0.7kgf/cm2 It reases to the above and the service condition of the motor commutator material of a motor is still severer. as ntioned above, it is now although it is asked for the material of the motor commutator which wear of Cu ɔregnation carbon brush also increases and can bear such a severe condition while the rate of arcing will increase if rotational frequency of a commutator is raised, and wear of the commutator [itself] of a motor will increase, if the ɔing pressure of the commutator of a motor and Cu impregnation carbon brush is increased further -- it does not ɜt

EANS

he means for solving a technical problem] Then, the result which inquired that this invention persons should get the tstanding motor commutator material which can bear a severe condition rather than the former from such a ;wpoint, The motor commutator material which consists of a Cu alloy which many Ag is contained rather than the)rementioned conventional motor commutator material, and Cr and Zr were added [alloy] fewer and made 1-50 m of oxygen contain further Abrasion resistance improved much more rather than the aforementioned conventional)tor commutator material, there were few rates of arcing and the knowledge of having the outstanding property was quired.

)05] This invention is made based on such knowledge (1). It is weight %. Oxygen:1-50ppm are contained Ag:7.5-% and Cr:0.05-1.2%. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder :omes from Cu and an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy ich has the decentralized organization (2), By weight % Oxygen:1-50ppm are contained Ag:7.5-15% and Zr:0.01-5%. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder becomes from and an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy which has the :entralized organization. (3) A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which /gen:1-50ppm are contained Ag:7.5-15%, Cr:0.05-1.2%, and Zr:0.01-0.25%, and the remainder becomes from Cu l an unescapable impurity by weight %, and a base. It has the characteristic feature in the motor commutator material ich consists of a Cu alloy which has the decentralized organization.

06] In the motor commutator material of this invention, since Cu impregnation carbon brush which is partner terial is worn while a degree of hardness will be too high and workability will fall as motor commutator material if is preferably contained on the other hand exceeding 15% since having carried out Ag content to 7.5 - 15% runs rt of the intensity and hardness of motor commutator material if Ag becomes less than 7.5%, it is based on it not ıg desirable. The much more desirable composition domain of Ag content of the motor commutator material of this ention is 9.0 - 11.0%.

07] Moreover, since Cr content was carried out to 0.05 - 1.2% because abrasion resistance and thermal resistance ıld not be improved, if Cr becomes less than 0.05%, its arcing will increase on the other hand if Cr is contained eeding 1.2%, and workability also becomes bad, it is based on it not being desirable. The much more desirable ıposition domain of Cr content of the motor commutator material of this invention is 0.2 - 0.6%.

)8] Furthermore, since workability also becomes bad while arcing will increase if it contains on the other hand erably exceeding 0.25% since thermal resistance runs short of this component at less than 0.01%, the ground which ted Zr contained in the motor commutator material of this invention to 0.01 - 0.25% is based on it not being rable. The much more desirable composition domain of Zr contained in the motor commutator material of this ntion is 0.05 - 0.15%.

)9] Furthermore, since workability also becomes bad while arcing will increase if oxygen contains on the other l preferably exceeding 50 ppm since the ground which limited the oxygen contained in the motor commutator erial of this invention to 1-50 ppm requires a cost for setting oxygen to less than 1 ppm too much, it is based on it being desirable. The much more desirable composition domain of the oxygen contained in the motor commutator erial of this invention is 1-15 ppm.

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ıult of implementation of invention] While Cu alloy was melted by the usual RF smelter and deoxidation essing which stands was performed, the ingot which has the dimension (diameter:175mm and length:400mm) h has the component composition shown in Table 1 and 2 was produced by adjusting the amount of Ag, Cr, and Zr h are added in the molten metal which carried out the seal with solid-state carbon. After carrying out a cold-

:awing manipulation after 720 degrees C and the hold during 60 minutes homogenize the obtained ingot until
truded between heat and it carried out so that it might become a dimension (diameter:50mm and length:7600mm),
id it subsequently carried out water cooling with the cooling rate of 50 degrees C/second or more and it was further
t to diameter:45mm, for 450 degrees C and 60 minutes, the hold carried out the aging treatment, the cold-drawing
anipulation was carried out further, and the diameter:40mm round bar made from Cu alloy was produced
011] The round bar made from these Cus alloy was cut to thickness:8mm, and the motor commutator material
onventionally henceforth commutator material) 1-4 was produced the disk-like this invention motor commutator
aterial (henceforth this invention commutator material) 1-11, the comparison motor commutator material (henceforth
mparison commutator material) 1-4, and conventionally. The cut surface of the obtained motor commutator material
as ground, it observed with the metaloscope, the number of the 0.2-5-micrometer sludges currently distributed in the
t-surface base of motor commutator material was measured, and the result was shown Table 1 and 2. Cu
pregnation carbon brush which has the dimension (diameter:5mm and length:10mm) which made porous material
rbon impregnate Cu furthermore was prepared.
012] The these disks-like commutator material 1 is attached in the shaft 3 of an electrical motor 2 as shown in
awing 1 . Cu impregnation carbon brush 4 is pushed against a 15mm place from the center of the disk-like
mmutator material 1, rotating the disk-like commutator material 1. making the graph which applied the constant
ltage of 10V between the disk-like commutator material 1 and Cu impregnation carbon brush 4, measured the
ltage which appears in a voltmeter 5, took the voltage along the axis of ordinate and took the resistance welding time
ng the quadrature axis draw The abrasion test was performed on condition that the following, the abrasion loss and
rate of arcing of commutator material and Cu impregnation carbon brush were measured, and the result was shown
Table 1 and 2. In addition, since the voltage became less than [9V] when the arc occurred, the rate of the resistance
lding time from which the voltage to all the resistance welding times became less than [9V] was made into the rate
arcing.
013] Abrasion test condition **** current:15A (76.43A/cm2), **** voltage:10V, forcing pressure:250gf
27kgf/cm2), turnover-time:24 hour, and rotational frequency:10000rpm.

Table 1

種別	成分組成 (重量%、但しO_2:(ppm))					析出物の個数 (個/mm²)	整流子の摩耗量 (mg)	Cu含浸カーボンブラシの摩耗量 (mg)	アーク発生率 (%)
	Ag	Cr	Zr	O_2 (ppm)	Cu				
1	.5	0.12	—	5	残	7500	430	9	10.2
2	8.5	0.85	—	5	残	9200	550	8	14.3
3	.1	—	0.08	4	残	1500	520	7	8.4
4	.3	—	0.21	3	残	3200	400	12	9.3
5	.6	0.30	0.07	6	残	5300	410	10	12.3
6	.8	0.85	0.08	10	残	8500	580	11	13.2
7	0.3	0.33	0.23	8	残	6200	470	11	12.5
8	.3	0.98	0.06	16	残	9400	620	12	14.0
9	3	0.10	0.10	23	残	7900	440	10	11.4
10	2	0.77	0.08	31	残	8800	570	11	10.7
11	.8	0.07	0.03	50	残	9500	640	13	17.2

区別	成分組成（重量%、但しO_2 (ppm)）					析出物の個数 (個/mm^2)	整流子の摩耗量 (mg)	Cu含浸カーボンブラシの摩耗量 (mg)	アーク発生率 (%)
	Ag	Cr	Zr	O_2 (ppm)	Cu				
1	5.4*	0.27	0.12	120*	残	22100	980	43	33.4
2	3.9*	0.08	0.09	65*	残	12500	1050	47	39.6
3	3.4	1.5*	0.12	18	残	25300	1140	38	28.8
4	10.2	0.45	0.4*	6	残	15600	920	48	29.3
1	1.3	−	−	−	残	−	925	8	9.4
2	4.0	−	−	−	残	−	850	11	10.2
3	0.03	0.02	0.03	−	残	5300	1020	13	12.3
4	2.1	−	−	−	残	−	980	14	11.8

（*印は、この発明の条件から外れた値を示す）

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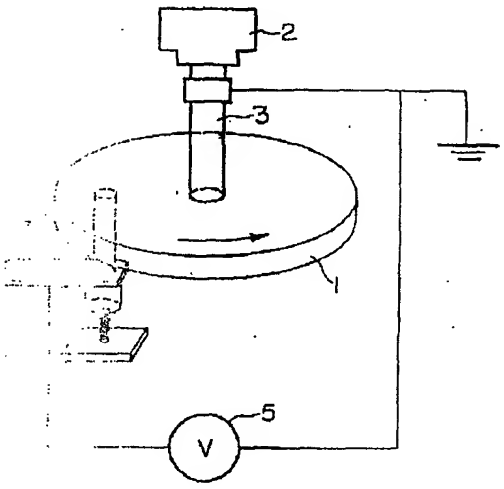
DESCRIPTION OF DRAWINGS

[Brief explanation of a drawing]
[Fig. 1] It is explanatory drawing showing how to measure the abrasion loss and the rate of arcing of commutator
and Cu impregnation carbon brush.
[Explanation of a sign]
Commutator Material
Electrical Motor
Shaft
Cu Impregnation Carbon Brush

[Translation done.]

DRAWINGS

[Drawing 1]



[Translation done.]